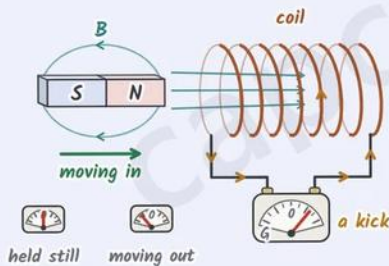


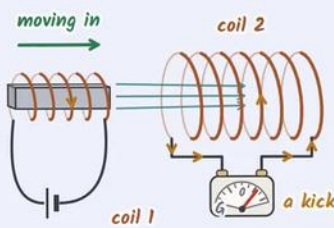
a changing flux is the only thing that ever induces an emf

Faraday's and Henry's experiments

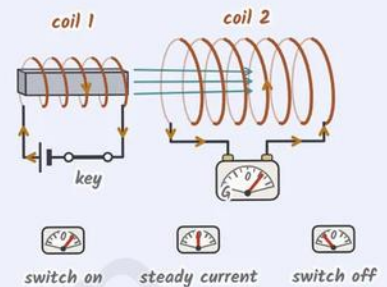
- a magnet moved toward a coil: the galvanometer **kicks** only while it moves; faster, bigger
- pulled away, the kick **reverses**; held still, no current at all
- a current-carrying coil carried in acts just like the magnet
- both coils still: switching coil 1 on or off kicks; a steady current induces **nothing**
- an iron rod through the coils makes the kick much bigger
- the common cause: the **magnetic flux** through the coil is changing



N end pushed in: a kick; still: none;
out: the other way



coil 1 and its cell carried in: the same
kick



coil 1 still: kicks at on and off only

Magnetic flux

uniform B through a flat area A

$$\Phi_B = BA \cos \theta$$

θ : between B and the area's normal

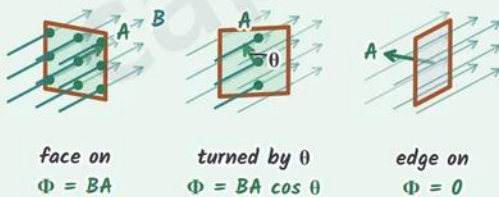
$$\Phi_B = B \cdot A$$

curved surface, non-uniform B

$$\Phi_B = \sum B \cdot dA$$

SI unit, the weber

$$1 \text{ Wb} = 1 \text{ T m}^2$$



face on every line threads the loop; edge on, none
a **scalar**: negative once the loop turns past 90°

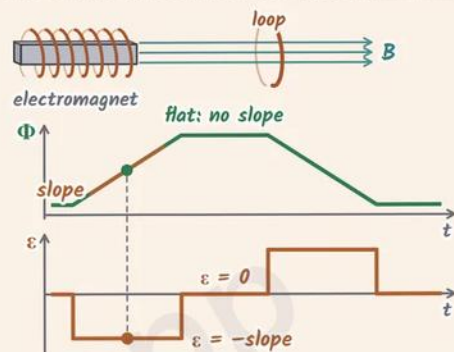
Faraday's law of induction

one loop

$$\mathcal{E} = - \frac{d\Phi_B}{dt}$$

N turns, each linking Φ

$$\mathcal{E} = -N \frac{d\Phi_B}{dt}$$



$\mathcal{E}$ is minus the slope of Φ : none while Φ holds
the **rate** of change of flux, never the flux itself